

What is Claimed is:

1. A method of generating an interference pattern with a lateral shearing interferometer that comprises the steps of:

(a) directing a source of radiation toward a test optic provided in a test-optic region of the lateral shearing interferometer whereby the test optic focuses a beam of radiation to an image plane located downstream from the test optic;

(b) dividing the beam of radiation into a first output beam and a second output beam directed at different angles with respect to one another such that the first output beam impinges at a first location on the image plane and the second output beam impinges at a second location, that is laterally separated from the first location, on the image plane, wherein the first and second locations on the image plane onto which the first and second output beams impinge define a beam-separation angle;

(c) phase shifting at least one of the first output beam and the second output beam;

(d) passing the first output beam through a first window on a mask that is positioned at the image plane of the test optic to produce a first wave and passing the second output beam through a second window on the mask to produce a second wave;

(e) recording a set of interference patterns (interferograms), with relative phase shifting between each element of the set;

(f) recovering a first shearing wavefront by processing the recorded interferograms in both temporal and spatial domains;

(g) repeating steps (b) through (f) at at least one different beam-separation angle to recover at least one other shearing wavefront ; and

(h) combining the shearing wavefronts to recover a test-optic wavefront.

2. The method of claim 1 wherein the sizes of the first window and second window are sufficiently small to prevent spatial-frequency cross-talk between adjacent orders in the recorded interferogram.

3. The method of claim 1 wherein the separation between the center of the first window and the center of the second window is at least two times the window width.

4. The method of claim 1 wherein the first window has an area of between $1 \mu\text{m}^2$ and 0.01 mm^2 and the second window has an area of between $1 \mu\text{m}^2$ and 0.01 mm^2 and the separation between the center of the first window and the center of the second window is between $2 \mu\text{m}^2$ and 0.2 mm^2 .

5. The method of claim 4 wherein the size and shape of the first window is essentially identical to that of the second window.

6. The method of claim 1 wherein the beam divider is a diffraction grating.

7. The method of claim 1 wherein the recording device is a charged-coupled device.

8. The method of claim 1 wherein step (f) comprises (i) bandpass spatial-filtering the individual phase-shifting interferogram's irradiance frames to form a filtered phase-shifting series, and (ii) using time-domain-based techniques to recover the shearing wavefront from the resulting filtered phase-shifting series.

9. The method of claim 1 wherein step (f) comprises (i) using time-domain-based techniques to recover the complex amplitude of the shearing wavefront from the phase-shifting series as a whole, and (ii) bandpass spatial-filtering the resulting complex amplitude to eliminate the spatial-frequency crosstalk from the shearing wavefront.

10. The method of claim 8 wherein the bandpass filter, as defined in the spatial-frequency domain, is (i) essentially equal to twice the test-beam window size as defined in the spatial-frequency domain and (ii) is centered on the positive- and/or negative-first orders of the recorded interferograms.

11. The method of claim 9 wherein the bandpass filter, as defined in the spatial-frequency domain, is (i) essentially equal to twice the test-beam window size, as defined in the spatial-frequency domain, and (ii) centered on the Fourier-domain peak of the complex amplitude.

12. The method of claim 1 wherein step (f) comprises embedding a bandpass spatial-filtering process into a time-domain technique algorithm, thereby, simultaneously processing the data in both the temporal and spatial domains.

13. A lateral shearing interferometer system that defines an optical path, said system comprising:

- (a) an optical system under test;
- (b) a source of electromagnetic energy that directs a beam of radiation toward the optical system which focuses the beam of radiation;
- (c) a beam divider in the optical path for dividing the beam of radiation from the optical system into a first beam and a second beam;
- (d) a mask that is positioned in the image plane of an optical system under test wherein the first beam passes through a first window on the mask and the second beam through a second window on the mask, wherein the first beam and second beam are directed at different angles with respect to one another such that the first beam impinges at a first location on the image plane and the second beam impinges at a second location, laterally separated from the first location, on an image plane, wherein the first and second locations on the image plane onto which the first and second beams impinge define a beam separation angle;
- (e) a phase shifting mechanism for adjusting the phase of at least one of the first beam or second beam;
- (f) a detector located downstream from the mask for recording a set of interference patterns (interferograms), with relative phase shifts between each element of the set;
- (g) means for recovering shearing wavefront by processing the recorded interferograms in both temporal and spatial domains; and
- (h) means for combing two or more shearing wavefronts that are measured at different beam separation angles to recover a test-optic wavefront.

14. The system of claim 13 wherein the sizes of the first window and second window are sufficiently small to prevent spatial-frequency cross-talk between adjacent orders in the recorded interferogram.
15. The system of claim 13 wherein the separation between the center of the first window and the center of the second window is at least two times the window width.
16. The system of claim 13 wherein the first window has an area of between $1 \mu\text{m}^2$ and 0.01 mm^2 and the second window has an area of between $1 \mu\text{m}^2$ and 0.01 mm^2 and the separation between the center of the first window and the center of the second window is between $2 \mu\text{m}^2$ and 0.2 mm^2 .
17. The system of claim 15 wherein the size and shape of the first window is essentially identical to that of the second window.
18. The system of claim 13 wherein the beam divider is a diffraction grating.
19. The system of claim 13 wherein the recording device is a charged-coupled device.
20. The system of claim 13 wherein the means for recovering the shearing wavefront comprises means for (i) bandpass spatial-filtering the individual interferogram's irradiance frames to form a filtered phase-shifting series, and (ii)

using time-domain-based techniques to recover the shearing wavefront from the resulting filtered phase-shifting series.

21. The system of claim 13 wherein the means for recovering the shearing wavefront comprises means for (i) using time-domain-based techniques to recover the complex amplitude of the shearing wavefront from the phase-shifting series as a whole, and (ii) bandpass spatial-filtering the resulting complex amplitude to eliminate the spatial-frequency crosstalk from the shearing wavefront.

22. The system of claim 20 wherein the means for bandpass spatial-filtering, as defined in the spatial-frequency domain, is (i) essentially equal to twice the test-beam window size as defined in the spatial-frequency domain and (ii) is centered on the positive- and/or negative-first orders of the recorded interferograms.

23. The system of claim 21 wherein the bandpass spatial-filtering means, as defined in the spatial-frequency domain, is (i) essentially equal to twice the test-beam window size, as defined in the spatial-frequency domain, and (ii) centered on the Fourier-domain peak of the complex amplitude.

24. The system of claim 13 wherein the means for recovering the shearing wavefront comprises a bandpass spatial-filtering process that is embedded into a time-domain technique algorithm, thereby, simultaneously processing the data in both the temporal and spatial domains.